BOOK REVIEWS

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The Wild Silk Moths of North America. A natural history of the Saturniidae of the United States and Canada.—Paul M. Tuskes, James P. Tuttle, and Michael M. Collins. 1996. Cornell University Press, Ithaca, N.Y. Hardcover, 250 pp., 30 color plates, 19 black-and-white illustrations, 22 drawings, 38 maps and overlays, 5 tables, 81/2 × 11. Cloth ISBN 0-8014-3130-1 $75.00.

The Saturniidae are simply the non plus ultra of big, dazzling moths: the charismatic megafauna of the insect world. Often mistaken for butterflies by non-entomologists, they are the specimens that collectors trot out for their relatives at Thanksgiving as examples of moths that are *not* small and brown (with occasional shades of gray). Saturniid workers never have to fish for complements or argue the attraction of their group by appealing to our appreciation for their subtle beauty. And as the most glaringly obvious examples of showy lepidoptera that are not butterflies, saturniids are at once the poster children for invertebrate conservation efforts and the standard bearers for moth biologists who wish a more widespread audience for their work. Perhaps most significantly, they provide the model for the "Lunar Moth" that carried away Dr. Doolittle at the end of Richard Fleisher's 1967 classic (actually, it resembles a Polyphemus more than it does a Luna; but at least 20th Century Fox got the subfamily right).

Tuskes et al.'s volume represents the first synthesis of the natural history of North American saturniids that combines taxonomic treatments with high quality color photographic plates of both adults and larvae. Pending the publication of LeMaire's eagerly awaited volume on the Hemileucinae, no single treatment or series of treatments has covered the North American fauna since Ferguson's (1971–72) Moths of North America (MONA) fascicle. In no case have the larvae or the life history details of the North American fauna been so thoroughly treated. Collins and Weast's (1961) volume was taxonomically restricted, treating only the Saturniinae and *Automeris*; and the works of Dyar (1902), Packard (1905, 1914), and Michener (1952) were more limited with respect to their coverage of natural history and/or the taxa and life stages figured. No work has attempted to figure as much of the range of North American saturniid larvae since Packard's (1905, 1914) excellent renderings of saturniid larvae at various instars. The Wild Silk Moths of North America thus fills a gap in the layman-friendly but thorough treatments of North American Lepidoptera. In a word, the summary of decades of life history work in this volume is masterful, and the large format, coffee-table style will make the book attractive to laymen as well as conservation biologists and expert and professional lepidopterists.

The Wild Silk Moths of North America is divided into two primary sections, plus an introduction, two appendices, a bibliography and two indices. Part One ("Behavior and Ecology") comprises seven chapters, of which the first four (Life History Strategies, Parasitism, Diseases of Saturniidae, and Populations, Species, and Taxonomy) are strictly biological in focus. Chapter One (Life History Strategies) is a broad but excellent primer on the holobiology of saturniids. Chapters two and three

(Parasitism, Diseases of the Saturniidae) comprise less that six full pages of text between them, prompting one to wonder why their subject matter was divided out into separate chapter headings. Chapter two, at least, is complemented by Appendix 1 (pp. 217–223) which summarizes referenced records of parasitization and hyperparasitization of the North American saturniid fauna. Chapter Four's discussion of population biology, speciation, systematics, and "the subspecies problem" is trite and largely misled, relying heavily on what appear to be the a priorist paradigms associated with long-outdated Mayrian evolutionary taxonomy. Chapter 5 provides a number of important collecting tips to the novice; likewise Chapter 6 is an excellent road map to the powers and pitfalls of rearing. Chapter 7, "Silk Moths and Human Culture", briefly summarizes the economic roles of saturniids in silk production, food, native american art, and as crop pests and medical hazards.

Part Two, Species Accounts, comprises the bulk of the volume's text and all of the plates. All three of the saturniid subfamilies with representatives in North American are treated; 85 taxa in total, of which all are figured as adults and 75 as larvae. The larval plates are among the selling points of this volume. The quality of the color plates is excellent, and will enable virtually anyone encountering these organisms in the field to identify them painlessly. As most biologists will recognize, showy colors and spectacular designs in nature rarely go unaccompanied by fascinating behavioral, ecological, and evolutionary features. The Saturniidae are no exception, and Tuskes et al. do an excellent job of asking intriguing questions and, to some extent, providing novel data towards answering them.

As it has for North American birds and butterflies, the systematics of North American saturniids appears to have reached a point where most of the genera are more or less stable and where taxonomic changes consist largely of subspecific transfers, elevations, or synonymies. Although it does not purport to be a phylogenetic revisionary work, and does not describe any new taxa, it effectively revises the North American saturniid fauna at the alpha level. Only one change is made at the generic level: *Syssphinx* is resynonymized under *Sphingicampa;* the reverse was the single generic change in Lemaire (1988) (Rindge, 1989). The other taxonomic changes in Tuskes et al. are as follows: ten subspecies are sunk to within the nominate form (*Eacles imperialis nobilis, Anisota stigma fuscosa, Anisota virginiensis pellucida, Anisota virginiensis discolor, Dryocampa rubicunda alba, Coloradia pandora lindseyi, Hemileuca chinatiensis conwayae, Hemileuca nuttalli uniformis, Automeris io lilith,* and *Antherea polyphemus olivacea*); one species is synonymized (*Hemileuca artemis* with *nevadensis*); two are elevated (*Antherea oculea*) or re-elevated (*Eacles oslari*) to species status; and three species are reduced (*Agapema anona platensis*) or re-reduced (*Hemileuca hera magnifica, Agapema anona dyari*) to subspecific rank. By comparison, Ferguson (1971–2) described two new species (*Sphingicampa blanchardi* and *Agapema solita*); four new subspecies (*Anisota stigma fuscosa, Anisota virginiensis discolor, Hemileuca eglanterina annulata*, and *Automeris iris hesselorum*); created two new combinations (*Hemileuca hualapai* and *Hemileuca chinatiensis*); synonymized one variety (*Pseudohazis hera* var. *arizonensis* with *Hemileuca nuttalli nuttalli*) and one subspecies (*Pseudohazis washingtonensis* with *Hemileuca nuttalli nuttalli*); elevated three subspecies or varieties (*Eacles imperialis oslari, Sphingicampa heiligbrodti hubbardi*, *Sphingicampa* [=*Adelocephala*] *hogei* var. *montana*) to species status; elevated one variety to subspecific rank (*Sphingicampa*

[=*Adelocephala*] *quadrilineata occlusa*); sunk two species to subspecies (*Coloradia pandora lindseyi, Coloradia pandora davisi*); and transferred one subspecies (*Hemileuca eglanterina uniformis* to *H. nuttalli uniformis*).

It will be observed that many of the taxonomic decisions of Ferguson (and others) are reversed in Tuskes et al.'s treatment. Such is the nature of the systematic endeavor: to pursue progress over stability. But one must wonder whether there continues to be undue focus at the infraspecific and infrasubspecific levels, given that none of the most recent volumes on the Saturniidae have made much of an attempt at phylogeny reconstruction. (The most rigorous attempt to address the phylogeny of the Saturniidae to date was that of a hymenopterist [Michener, 1952] during his tenure at the American Museum of Natural History, and was strongly contested by lepidopterists [Forbes, 1952].) As a phylogenetic systematist, I find this emphasis not uncoincidental with the authors' adherence to the biological species concept, and I fear that the shift away from macroevolutionary taxonomic questions to species-level taxonomic questions attributable to Mayr has been slow to reverse itself in the lepidopterist community.

Relatedly, the volume suffers, in my opinion, from a chronic problem in its portrayal of species delineation and speciation. The author's application of hybridization studies to the delimitation of species is foreshadowed in what can only be seen as a rather outdated discussion of the species problem (pp. 3–4), and in the somewhat weak attempt in Chapter 4 to integrate evolution within populations and speciation. Throughout the book the discussion of specific (and infraspecific) delineation (their "evolutionary view of the species") is couched in Mayrian terms of interbreeding, hybridization, and subspecific process-related assumptions. The *Hemileuca maia* complex is referred to as a "superspecies" (p. 111); following Tuskes and Collins (1981), *Saturnia mendocino* and *S. walterorum* are referred to as "semispecies" (P. 163). *Automeris io lilith* is synonymized under nominate *io* on the grounds that it "does not have a distribution pattern consistent with the subspecies concept" (p. 152). In fact, such terminology does not serve to clarify, but rather to confuse the logical relationship between alpha systematics and phylogeny reconstruction. It serves as well to misdirect the focus of systematic research away from recovering an underlying pattern from within which to test hypotheses, and towards an assumption-laden, process-oriented approach from within which hypothesis testing is impossible.

One of the primary purposes of systematics is to provide an independent framework for the examination of biological processes. In contrast, Tuskes et al. (p. 32) state: "A consideration of the process of speciation is important in order to understand the controversy over what constitutes a species and what taxonomic rank should be assigned to a given population". And later in the same paragraph: "Any theory of speciation must explain the transition from one stable, harmonious system of interacting genes to another such system." Throughout the volume, the authors conflate the discovery operations used by systematists to delineate species with the process of speciation itself. Interbreeding and hybridization are thus seen as a tool for taxonomy rather than a phenomenon to be examined following character-based phylogenetic reconstruction. Reproductive isolation is repeatedly referred to as a "test" of species status. This approach, with its obligate reliance on the ability to produce fertile offspring, effectively abandons character-based systematic inference; indeed, one of the authors refers to morphological attributes as "indirect" (Collins, 1997). But the practice of systematics depends ulti-

mately on character-based species diagnoses. Only character-based diagnoses can lead to hypotheses of phylogenetic schemes and classifications if they are to be based on synapomorphyies. Species may certainly be "lost" by hybridization, which obscures phylogenetic pattern, but it is not acceptable to lump historically distinct entities because of what may (or may not) happen in the future.

The authors' adherence to the biological species concept is troublesome for other reasons. Tuskes et al. do not address the requirement that a species criterion must be consistent and operational if it is to apply to all organisms, and that not only are requirements of interfertization impossible to use consistently (they are irrelevant for asexual taxa, for example), the ability to interbreed may be plesiomorphic as well. In fact, Tuskes et al.'s Appendix Two "Saturniid Hybrids" (pp. 224–5), includes a number intergeneric crosses. It must be recognized that hybridization experiments such as those conducted by the authors are at best one-sided tests. Failure to produce fertile offspring may well be sufficient evidence from which to conclude that two putative species are distinct, as do Tuskes et al. for *Eacles oslari* and *Antheraea oculea.* But the ability to interbreed—the author's primary justification for re-synonymizing *Hemileuca artemis* with *H. nevadensis*—cannot be invoked as de facto "proof" of legitimately character-based identification of conspecificity. Nonetheless, the authors are rather conservative in their taxonomic changes, sinking many more taxa than they elevated. Almost every such synonymy is based on refutation of allegedly diagnostic characters, the exceptions being *Hemileuca artemis* and *Hemileuca nuttalli uniformis* (whose distribution, the authors state on p. 144, "is inconsistent with that of a subspecies"). Perhaps the authors of this volume should either have included a review of higher level saturniid relationships (to the extent possible) or not devoted as much space trying to reconcile their notions of species with character data.

Distributions, flight times, calling times, and host plant records (as well as at least one first-time larval description; *Hemileuca hualapai*, p. 108) are among the most valuable aspects of the volume's content. The volume is noteworthy for describing rangewide variation in flight times and development. The text is chock-full of useful basic natural history information and is at times downright entertaining. I was delighted to learn that the etymology of the Buck moth derives from the belief that the moth larvae developed in the heads of deer and that the adults fly from the bucks' nostrils (p. 111). Likewise the anecdote of the polyphemus caterpillars' sharing similar optical spectra with harvested plums and getting sorted mechanically into the prune processing machinery (p. 177) was most amusing. With almost 550 references, the bibliography is extensive, drawing on reports and season summaries by amateurs as well as revisionary and other empirical work by professionals. It serves as the most complete guide to the saturniid literature of which I am aware.

Tuskes, Tuttle, and Collins are to be congratulated for their synthesis of North American saturniid life histories. This volume is an up-to-date compilation of available natural history data that serves admirably both as a field guide and as an introduction to students, natural historians, and other biologists with an interest in silk moth biology. While their philosophy of systematics leaves something to be desired, their obvious dedication and diligence with respect to addressing basic natural history questions has resulted in one of the best lepidopteran natural history texts I have ever seen, and one that will no doubt set the standard for North American moth life history books for decades to come.—

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Click beetles: Genera of the Australian Elateridae (Coleoptera).—Andrew A. Calder. 1996. 401 pp., 420 figs. including 90 excellent habitus drawings. About $100.00 U.S.

This appears to be an excellent reference to the genera of Australian click beetles. The illustrations are excellent, especially the habitus ones. The treatment for each genus starts with the original citation, synonymy if any, and the type species. This is followed with a very detailed description that is the equivalent of just over two pages plus about three more pages of illustrations. Finally, there is a short section on geographical distribution (world and Australian), a list of the Australian species,